

POST-POLIO SYMPOSIUM '86

Respiratory Considerations in Post-Polio

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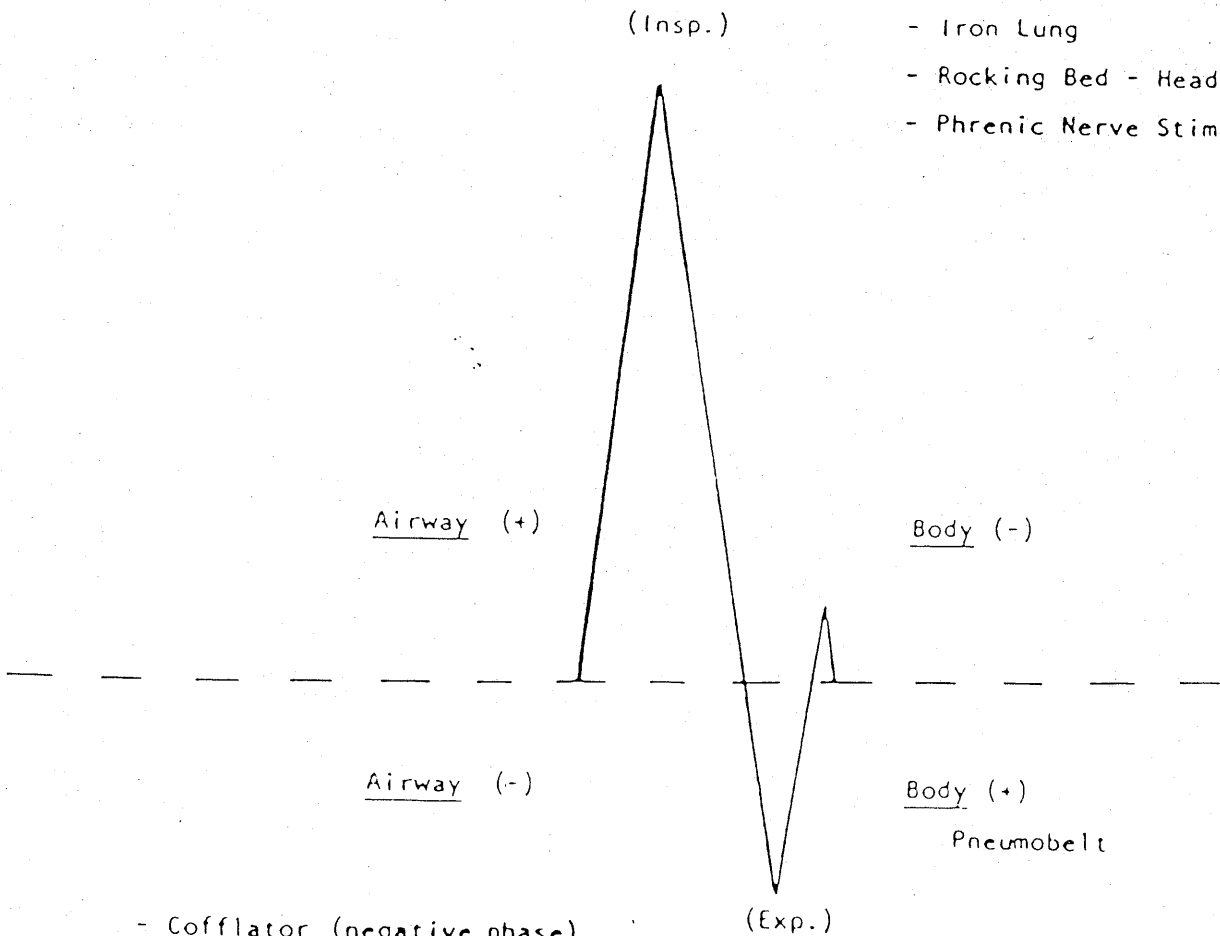
Bethesda, Maryland

Respiratory assistive devices superimposed on a graphic representation of the vital capacity

IPPV

- Volume Respirator - Console
- Pressure Respirator - Console
- Volume Respirator - Compact
- Pressure Respirator - Compact
- Manual Resuscitator/Ventilator
- Mouth-to-mouth,
to mouth-nose,
to tracheostomy
- Cofflator (positive phase)
- High frequency ventilator
- GPB

- Inspiratory Muscles
- Cuirass
- Iron Lung
- Rocking Bed - Head Up
- Phrenic Nerve Stimulation



- Cofflator (negative phase)
- Suctioning - suction machine (AC)
- Portable suction machine (AC/DC)
- GPB-reversed

- Expiratory Muscles
- Pneumbelt
- Rocking Bed - Head Down
- Manual Body Resuscitation

IPPV Ventilator

Purpose/Goals:

- to decrease or take over the work of breathing; thereby, decreasing the work of the heart.
- to maintain adequate alveolar ventilation.
- to improve the efficiency of oxygenation and/or ventilation through regulation of airway pressures and ventilatory pattern.
 - to improve compliance by deep breathing
 - to overcome paradoxical breathing by controlled ventilation.
- to produce a cough (Coflator)
- to nebulize medications, water.

HOME RESPIRATORY THERAPY

- patient education
- bronchial hygiene regimens
- relaxation techniques
- diaphragmatic retraining
- breathing exercises
- support and coaching
- arterial blood gases
- pulmonary function tests
- sputum cultures and sensitivities
- mobile electrocardiograms
- ventilator management of chronic ventilator patients
- tracheostomy care

GLOSSOPHARYNGEAL BREATHING

Effective GPB:

A stroke of at least 1% of predicted normal VC. Average stroke of 60 ml. Speed of 60-200/min. with average 100/min.

Minute Ventilation of GPB in the Adult:

Average stroke 60 ml. Average volume of a single breath 700 mls. Average number of breaths/min - 6/min. Average minute ventilation 3800 mls.

Use of GPB:

- Seventy percent for assisted breathing -
- 60% only means of being off respirator
 - 40% some "free time".

Thirty percent for stretching chest, coughing, and as an aid in talking.

INSTRUCTIONS IN GPB *

Individual instruction for 30-60 min., 3 x's/wk., for 1-6 weeks.

Method:

- Supplement deepest voluntary breath with GPB until pressure in throat and upper chest is experienced.
- Count aloud as air is expelled.
- Cough as air is expelled.
- Hold breath to count of 10.
- Expel air against pursed lips.

Patient to work by self 10 minutes, 2-3 x's/day. Formal therapy discontinued when GPB-VC is stable for two weeks.

* Instructions taken from article on "Effects of Glossopharyngeal Breathing on Respiratory Function After Cervical Cord Transection," by Jose Montero, M.D., Daniel Feldman, M.D., and Dorothy Montero, O.T.R., Archives of Physical Medicine & Rehabilitation, Dec. 1967.

Positive Pressure Ventilatory Aids

Why use mouth IPPV?

- portability of the respirator.
- large volume of air delivered per breath.
- avoidance of the complications of tracheostomy.
- need for only 1-2 of the same type of respirator; quantity depends on time off the respirator.
- ability to use GPB concurrently with MIPPV.
- ability to take double and even triple breaths at the same pressure for sighing. Bagging, adjustment of the volume or the pressure on the respirator to a higher level for sighing periodically, or an automatic sigh on the respirator is not needed.

Who can use MIPPV?

- Persons with normal oropharyngeal and laryngeal muscles or at most minimal weakness.
- Persons with a competent soft palate or, if not, who are willing to use a noseclip or cotton plugs or similar device to prevent nasal leakage.
- Persons who are motivated to free themselves from body respirators or a tracheostomy and who are willing to undergo the minimal training required to use it during the day.
- For use during the night, the person may need to practice for a considerable period of time during the day and during light sleep (napping) before he can use it at night during deeper sleep. Use during the night is as the result of a conditioned reflex in sleep, and for some occurs immediately; for others it may take six months or more.

What attachments for mouth, nose, or mouth-nose IPPV exist?

- angulated mouthpieces, small and large. (can be used at night by some)
- straight mouthpiece with Bennett lipseal, used with either 1-2 plastic straps with hook, level of the mastoids, or with canvas straps with Velcro closure above and below the ears. (night use)
- Custommade ventilating mouthpiece with acrylic mold of upper and lower jaw and teeth with opening for rigid tube. If mouth tends to fall open, a chin mold can be added. The head halter used for cervical traction can be modified to hold the mouth closed.
- Nasal mask and nasal prongs with foam seal have been used with CPAP, and are now being tried with IPPV.
- Complete face mask - more comfortable models are being designed.
- Complete head dome has been tried with infants for CPAP but there is a problem with seal. It is available on some Emerson iron lungs for mouth-nose IPPV. Effective if pressures below plus 25 cm H₂O are adequate.
- Attachments can be held in place with gooseneck and broom holder attached to gooseneck with hose clamp, with baby bottle holder, or similar device.

What problems and complications can occur?

- allergy to materials strapped to face, biting through plastics, more difficult if edentulous, need to avoid any form of sedation if used during sleep.
- aerophagia, tension in jaws and lips, drying of mucous membranes if humidification is not adequate, harmful effect on teeth during long term usage (open bite, loosening and slanting of front teeth forward or backwards; may need extraction of teeth in lower jaw with replacement by permanent partial bridge.)

Why use a body respirator?

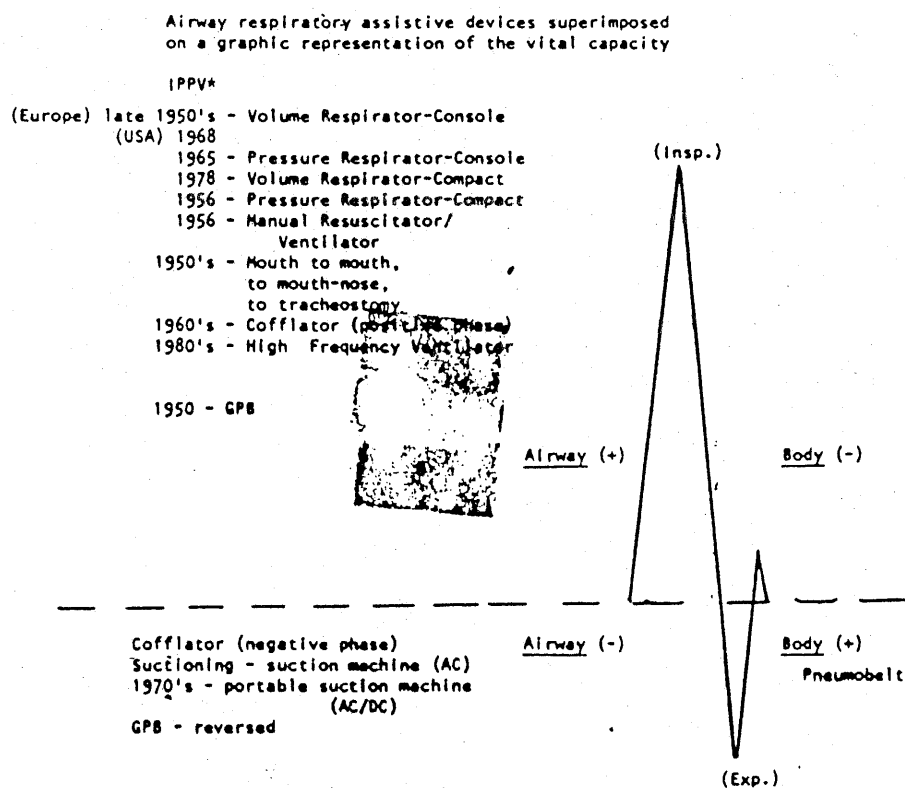
- If person does not want or need a tracheostomy, and mouth IPPV cannot be used in sleep, a body respirator will be needed.
- When person is awake and at least in a semi-sitting position, he may prefer a pneumobelt; if supine, a cuirass, to free his mouth for other activities (reading or painting with mouthstick.) Person may prefer, at least part of the time, the movement provided his body in the rocking bed.

When does one change to TIPPV?

- Obstructed upper airway, mechanical or paretic.
- If person is subject to drug or alcohol abuse, is confused, anxious or psychotic, is in an acute toxic-metabolic state with decreased level of consciousness, he cannot use MIPPV reliably.
- If person has shown repeatedly that he is unable to handle secretions with the caretakers available; if he has had recurrent atelectases, chronic bronchitis and recurrent bronchopneumonia, or recurrent aspiration.
- If TIPPV is needed during the night, the person may prefer to continue to use it during the day rather than plugging his tracheostomy tube and using a fenestrated tube with a deflated cuff or without a cuff.
- Infants and small children with no reserve and with small airways requiring careful suctioning to maintain life.
- TIPPV in alert, cooperative adults can be used without a cuff or with a deflated cuff during the day; with training, it can also be administered this way during the night.

What complications can occur with TIPPV?

- Early complications include pneumothorax, subcutaneous emphysema, positive water balance, gastrointestinal complications, pulmonary oxygen toxicity, endobronchial intubation, postop. wound infection.
- Complications occurring at any time include increased secretions with atelectasis, pulmonary infection, tracheal damage with stenosis, or localized cuff trachiectasis, granulation tissue formation on anterior wall of the trachea above the stoma causing bleeding and possible obstruction of the upper airway, obstruction of the airway by mucus plug in the tracheostomy tube, psychosocial problems. These include disability for work because of rejection by employer, rejection by family members, increased dependency reactions, depression.



*Date represents time when apparatus or technique became readily available.

TEACHING GUIDE FOR HOME VENTILATION*

- I. Trach Tube Itself
 - A. Cuff Inflation/deflation
 1. Principles involved/procedures
 - B. Trach Change
 1. Frequency
 2. Procedure
 3. Safety Measures
 - a. Check tidal volume
 - b. Trach change kit
 - c. Listen/feel chest
 - C. Trach Ties Changing
 1. Procedure
 2. Safety
 - D. General Observations
 1. Humidification
 2. Accidental balloon line cut
 3. Cuff malfunction
- II. Stoma Care
 - A. Cleansing
 - B. Dressings
 - C. Safety, i.e. no lubricant
 - D. General Observations
 1. Redness
 2. Purulent drainage
- III. Suction Procedure
 - A. Principles of sterile technique
 - B. Procedure of sterile technique
 - C. Ambu
 1. Cleaning
 2. Maintenance
 - D. Irrigation
 1. Principle
 2. Procedure
 - E. Observations of Sputum
 1. Change in color
 2. Change in consistency
 3. Change in odor
 4. Change in amount
 - F. Methylene blue dye test to rule out aspiration
- IV. Spontaneous Vents
 - A. Operation of Wright Spirometer
 - B. Parameters to measure
 1. Tidal volume
 2. Rate
 3. Minute ventilation
 4. PNP
 - C. Observations
 1. Change in above parameters
 2. Work of breathing, i.e. muscles in neck, belly, intercostals
- V. Ventilator
 - A. Alarm System
 - B. Humidification, i.e. Cascade
 1. Operation of temperature control
 2. Filling of sterile water
 3. Emptying of tubings with H₂O.

- C. Cleaning/changing tubings, filters
 - D. Dials
 - E. Substitute - Ambu
- VI. Supplies Needed - Minimum
 - A. Cuff Pressure
 1. Stopcock
 2. Syringes
 3. Manometer
 - B. Stoma Care
 1. Trach Ties
 2. H₂O
 3. Sterile trach dressings
 - C. Trach Change Kit
 - D. Suction
 1. Suction catheters
 2. Connecting tubing
 3. Suction machine
 4. Rinse cups
 5. NS irrigators
 6. Ambu bag
 7. Tonsil tip suction
 - E. Ventilator
 1. Wright Spirometer
 2. Adaptor for PNP
 3. Green tubing (O₂ connecting)
 4. Sterile H₂O
 5. Ventilator tubing
 6. Flex tubes (Ambu/vent)
 7. ET adaptor
 - F. Other Factors to Consider
 1. Use of O₂ tanks
 2. Early VNA consult to observe care in hospital
 3. Legal aspects of home ventilation

*Prepared by University of Colorado Health Science Center. Shared by Thompson Respiration Products, Boulder, Colorado.

-Patient, family member and/or staff member are instructed, give a return demonstration and become certified in each area.

Appendix: Some Features of Positive-Pressure Home Care Ventilators

	LIFE PRODUCTS INC				PURITAN-BENNETT CORP					
	LP-3	LP-4	LP-5	LP-6	Maxi-Vent	Bantam-GS	M25B	M 3000XA	2800	
Modes	Control	C	C	C	C	C	C	C	C	
	Assist/Control	A/C	A/C	A/C	A/C	—	—	A/C	A/C	
	IMV, SIMV	—	IMV	IMV	SIMV	—	—	IMV	SIMV	
	Tidal volume range (ml)	0-3,000	0-3,000	100-2,000	100-2,000	Variable	Variable	300-2,500	200-3,000	50-2,800
	Rate range (per min)	8-30	5-30	2-28	1-38	8-24	6-24	4-23	6-30	1-69
	I:E-fixed or variable	Fixed 1:1	Fixed (C) 1:1 Variable (A/C, IMV)	Variable	Variable	Fixed 1:1	Fixed 1:2.5	Variable	Variable	Variable
	Approximate, maximum pressure (cm H ₂ O) and pressure limit—ends inspiration (EI) or holds peak pressure (HPP)	100	100	80	100	80 (-70 cm H ₂ O)	55	65	65	70
	Typical flow pattern: sine or decelerating (decel)	sine	sine	sine	decel	decel (variable)	decel (variable)	sine	sine	sine
	Low pressure	yes	yes	yes	yes	yes	yes	yes	yes	yes
	High pressure with pressure limit	no	no	yes	yes (except in pressure limit mode)	no	no	no	no	no
Alarms or Controls	High pressure separate from press limit	yes	yes	no	no	no	no	yes (factory set)	yes	yes
	I:E	no	no	yes	yes	no	no	no	yes	yes
	Insp flow	no	no	yes	no	no	no	no	no	yes
	Apnea	no	yes	yes	yes	no	no	no	no	yes
	Low battery or power loss	yes	yes	yes	yes	yes	yes	yes	yes	yes
	Alarm silence	no	no	yes	yes	yes	no	no	yes	yes
	Can provide negative pressure	no	no	no	no	yes	no	no	no	no
	Reservoir for O ₂ addition available	no	no	yes	yes	no	no	yes	yes	yes

LIFECARE

BEAR
MEDICAL

	170C	RBL	PVV	PLV-100	PLV-102	Bear 33
Modes	Control	C	C	C	C	C
	Assist/Control	—	—	—	A/C	A/C
	IMV, SIMV	—	—	—	SIMV	SIMV
Tidal volume range (ml)	Variable	Variable	0-3,000	50-3,000	50-3,000	100-2,200
Rate range (per min)	10-40	6-24	8-30	2-40	2-40	2-40
I:E-fixed or variable	Fixed 1:1.5	Fixed 1:2.5	Fixed 1:1	Variable	Variable	Variable
Approximate, maximum pressure (cm H ₂ O) and pressure limit—ends inspiration (EI) or holds peak pressure (HPP)	60 (-60 cm H ₂ O)	55	100	100	100	80
Typical flow pattern: sine or decelerating (decel)	decel (variable)	decel (variable)	sine	sine	sine	sine
Alarms or Controls	Low pressure	no	no	yes	yes	yes
	High pressure with pressure limit	no	no	no	yes	yes
	High pressure separate from press limit	no	no	yes	no	no
	I:E	no	no	no	yes	yes
	Insp flow	no	no	no	yes	yes
	Apnea	no	no	no	yes	yes
	Low battery or power loss	yes	yes	yes	yes	yes
	Alarm silence	no	no	no	no	yes
	Can provide negative pressure	yes	no	no	no	no
	Reservoir for O ₂ addition available	no	no	no	no	yes

Chest Physical Therapy

Conditions Treated

Atelectasis
Pneumonia
*Ventilated patient
Unconscious patient
*Cystic fibrosis
Asthma
*Chronic bronchitis
Emphysema
Bronchiectasis
The COPD patient.

*most frequently studied conditions.

Chest Physical Therapy

Treatment Techniques

- Breathing exercises
- Postural drainage
- Percussion
- Vibration
- Coughing
- Manual facilitation

Chest Physical Therapy

Treatment Techniques

- Breathing exercises: •deep breathing
•expansion exercises
•manual facilitation techniques.
- Postural drainage: •modified
•with coughing
•with suctioning (speed to avoid hypoxemia, especially in circulatory failure)

Chest Physical Therapy

Treatment Techniques

Percussion, tapotement.

Vibration: •mechanical - electrically powered massage chair, vibrating pad, hand-held vibrator.

•manual

•manual expiratory

Chest Physical Therapy

Outcome Criteria

PFT's - vital capacity, tidal volume, minute volume, work of breathing, alveolar pressure.

- FEV₁, specific airways conductance, flow rates.

ABG's - PaO₂, PaCO₂, A-a gradient.

Cardiac output.

Sputum - volume, rate of clearance of tracheo-bronchial tree.

Clinical Status - temperature (fever) -duration, height; length of hospital stay rate of clearing of chest x-ray, mortality.

Illustrative Case History of Post-polio Ventilator Dependent Person.

I.H. , M., DOB 10/1/39

Dx: postpolio quadriplegia
including neck, 1955

PFT's:

VC - zero

FRC wearing pneumobelt
54% (7/80); 46% (9/82)

DLCO_{ss} 9.7 (9/82)

(ml/mmHg/min)

10/84

I.H., M., DOB 10/1/39, polio quad. 1955

1955 few mos. iron lung; contin-
ues to use iron lung for
respiratory infections.

1956 - 1981 chest shell nighttime
pneumobelt sitting 12-14 hrs.
MIPPV, daytime, supine.

1981 trial of poncho

1981 to date MIPPV with lipguard nighttime

10/84

I.H. , M., DOB 10/1/39, polio quad. 1955

Tidal volume on pneumobelt:

0.37L (5/83); 0.3L (7/84)

Cuirass: 0.32L (1981)

MIPPV with lipguard: 0.60L (1981)

Sigh on MIPPV: 40 cm H₂O - 1.85L (5/83)
26 cm H₂O 0.80L (7/84)

GPB - VC - 1.6L (7/84)

10/84

Illustrative Case History of Post-polio Ventilator Dependent Person.

E.R., F., DOB 2/1/24
postpolio quadriplegia, 1953

PFT's
VC - 10% (1964); 8% (1984)
FRC - 24% (1977); unable to perform since.

MIP - 3 mm Hg (1982)
MEP - 3 mm Hg (1982)

DLCO_{SS} - 4.3 ml CO/mm Hg/min. (1977)
- 9.0 (1982)

10/84

E.R., F., DOB 2/1/24, polio 1953

Volumes with/without respirator, sitting:

No aid:

TV - 0.13 - 0.30L (1983-1984)

Pneumobelt TV - 0.26L (1964); 0.22L (1982)

GPB - VC 0.89L (1984)

Sigh on bantam - 42 cm H₂O - 1.0L (1984)

10/84

E.R., F., DOB 2/1/24, polio 1953

Volumes with/without respirator, supine:

Chest piece TV - 0.31L (1982)

Rocking Bed - 30-30 TV - 0.31L (1980)

GPB - VC - 0.8L (1984)

Sigh on bantam - 42 cm H₂O - 0.67L (1984)

MIPPV with lipguard -
25 cm H₂O TV - 0.54L (1979)

10/84

E.R., F., DOB 2/1/24, polio 1953

1953 - 1957 rocking bed or chestpiece
fulltime.

1957 - 1982 MIPPV with mouthpiece day-
time in bed, including napping

1957 - 1980 pneumobelt in motorized w/c.

1980 to date MIPPV in w/c.

1982 to date MIPPV 24 hrs/day;
lipguard nighttime.

Illustrative Case History of Post-polio Ventilator Dependent Person.

N.B., F., DOB 10/29/41

1947 - onset post polio quadriparesis,
moderate-severe scoliosis, UE's 1/5

9/84 - PFT's standing with corset,
weight 84.5 lbs.

VC - 0.5L (23%)
Sigh with Bantam - 0.9L
GPB-VC - 1.3L (1.6 L 1/83)
TV - 0.23L

10/84

N.B., F., DOB 10/29/41, polio, 1947

9/84 - PFT's cont'd
P_EC_{O2} - normal.
PEF - 1.8LPS (37%)

MVV - 12%
FRC - 31%

LCI - 204%, moderate impairment
DLCO_{sb} - 3.2 (23%)

MIP - 26 mm Hg
MEP - 32 mm Hg

10/84

N.B., F., DOB 10/29/41, polio 1947

9/24/84 - DLCO_{sb} - 3.2 (23%)

9/24-9/27/84 - MIPPV 1-2 hrs. bid and
GPB practice

9/27/84 - DLCO_{sb} - 6.4, 8.7 (45%, 62%)

- DLCO_{ss} - 6.8

- DLCO_{ss}, GPB - 12.2

10/84

N.B., F., DOB 10/29/41, polio 1947

1964-1966 - MIPPV gray mouthpiece prn during
day, and watching TV evenings.

1966-1981 - As above plus all night. When it
dropped out of mouth, breathed on
own for a while, then in sleep
picked it up and breathed with it
again.

1981-9/84 - covered face and mouthpiece with
scarf, lying on stomach with face
in scarf.

9/84 - 2-3 ms. headaches during night or
in AM on awakening; began using
MIPPV with lipguard.

10/84 - no headaches.

10/84

N.B., F., DOB 10/29/41

1947 - polio

1966 to date - sleeps with MIPPV

9/84 - TV - supine, no aid - 0.39L
(74% VC)

- TV - supine, bantam
lipguard
25 cm. H20, F-12 - 0.48L

10/84